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EMBRYOLOGY.[1]

Development of Sponges.[2]—Otto Wass in a comprehensive paper describes the egg development and metamorphosis of several representatives of the Cornacuspongiae, including under this head the Monaxonida, with the exception of the Clavulina and the horny sponges. For the Monaxonida the embryonic development of *Myxilla* and *Chalinula,* and the metamorphosis of *Axinella* and *Gellius,* are described in detail. For the horny sponges, the development of *Euspongia* and *Hircinia* is outlined. In addition, there are scattered observations on many other Naples cornacuspongiae, and lastly the author presents the results of a renewed study of *Spongilla.*

A fundamental uniformity both as regards embryonic development and metamorphosis, was found to prevail throughout these sponges. The account of the metamorphosis differs but little from the author's previous account of the metamorphosis of the *Esperia* larva, and is very similar to that given by Yves Delage in his last paper (reviewed in the January NATURALIST).

In the marine monaxonida described, the segmentation is unequal. Micromeres in an epibolic fashion surround a mass of macromeres, except at the posterior pole. The micromeres become the ciliated epithelium of the larva, the macromeres constitute the inner mass. The larva thus consists of two layers. In the inner mass some of the cells remain undifferentiated, while the rest alter both in nucleus and cell body, and are collectively known as differentiated cells. Certain of these differentiated cells arrange themselves in an epithelial manner at the surface of the posterior pole. The undifferentiated cells of the inner mass become the amoeboid cells of the adult, from which the reproductive elements are developed. Thus the division into germ and somatic cells is very early brought about.

In the horny sponges the segmentation does not lead to a true morula which dilaminates into an outer layer and an inner mass, as Schulze thought. The segmentation here too is unequal, and the micromeres surround the macromeres as in the monaxonida, the former becoming the ciliated epithelium of the larva, the latter the inner mass. But in the larva of the horny sponges, as in that of *Spongilla*, the ciliated epithelium is continuous over the whole surface. This is explained by supposing that in these types the ciliated epithelium (micromere layer) completes its growth around the inner mass, which in the other sponges is left bare at the posterior pole.

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[1] Edited by E. A. Andrews, Baltimore Md., to whom communications may be addressed.

[2] Die Embryonal Entwicklung und Metamorphose der Cornacuspongien, von Dr. Otto Wass, Zoologische Jahrbücher. Abth. für Anat. und Ontogenie. Bd. VII, 2 Hft., 1893.

In the metamorphosis of the two-layered larva of the cornacuspongiae, a complete inversion of the layers take place. The ciliated cells draw in their cilia, and migrate into the interior of the sponge where they form a compact mass, surrounded by the former inner layer. Certain of the differentiated cells of the latter layer unite to form the thin epidermis of the adult. The boundary line between the rest of this layer and the inner mass of once ciliated cells gradually disappears, elements belonging to both layers becoming distributed irregularly throughout the sponge body (process of "durchwachsung"). Groups of the ciliated cells now begin to develop into flagellated chambers. Independent spaces or lacunae appear and become gradually lined with an epithelium formed by the differentiated cells of the larval inner layer. These spaces are the canals. Connection between them and chambers is subsequently established. In two points Wass differs from Delage, in his account of the metamorphosis. Delage believes a special layer of cells, the epidermic cells, can be distinguished in the larva, which during the metamorphosis, take the place of the ciliated cells as a superficial covering. Wass finds no ground for distinguishing the cells which thus form the adult epidermis, from the other differentiated cells of the larval inner mass. Again Delage believes that during the metamorphosis the undifferentiated cells engulf, amorba like, the smaller ciliated cells, subsequently letting them go free to form the flagellated chambers. Wass disbelieves in this remarkable process, though he grants the possibility of amoeboid cells occasionally engulfing ciliated cells, which however are never after liberated, but undergo degenerative changes (i. e. are digested).

On going over the *Spongilla* development the author, aided by his discoveries in marine sponges, finds that a different interpretation in many particulars is to be put upon his earlier observations. The segmentation is not equal, but unequal. A true morula is not established, but instead the smaller blastomeres surround the larger. The ciliated epithelium of the larva is not transformed into the adult epidermis, but the inversion of layers described above takes place in *Spongilla* also. The exhalent canals and flagellated chambers are not formed as diverticula from a single main cavity, nor are the inhalent canals formed as invaginations of the "ectoderm," but both sorts of canals arise as independent lacunae, subsequently acquiring an epithelium and connecting together, and the chambers are formed from groups of the immigrated cells. The development of *Spongilla* is thus brought into accord with that of the marine cornacuspongiae.

In a comparative review of the various types of sponge development, the author points out the fundamental similarity between the development of the cornacuspongiae and that of the calcareous sponges, as exemplified in *Sycandra.* The ciliated cells are homologous in the two kinds of larva, as are the granular cells of the amphiblastula and the inner mass of the other larva. The difference in the character of the metamorphosis arises from the fact that in the amphiblastula there is a large cavity, while in the larva of cornacuspongiae there is none. In this comparison Wass and Delage agree.

The author thinks the development of those sponges (*Ascetta, Oscorella, Plaxira,* etc.), which apparently differ from the plan of development described in this paper, needs to be worked over. A fundamental harmony with the development of cornacuspongidae and *Sycandra* will be revealed.

Touching the relationship between sponges and the other metazoa the author, without dogmatizing, is inclined to believe that they had a common ancestor above the protozoa. This ancestor is represented in the two-layered larva of both. But the community of origin goes no higher than this simple form—the sponges are not coelenterates. In the two-layered ancestor of the sponges, the superficial ciliated cells migrated into the interior, resigning their function of locomotive organs in order to generate internal currents of water, made necessary by the adoption of a fixed habit of life with subsequent increase of bulk. In other metázoa, the ciliated cells continue to form the superficial covering of the body. The immigration of the ciliated cells in the larva of cornacuspongiae, and the invagination of the ciliated cells in the Sycandra amphiblastula, are the ontogenetic expression of this change of position of the ciliated cells in the early ancestors of sponges, and have nothing to do with a process of gastrulation—the two-layered embryo being already formed before the occurrence of this immigration or invagination.

H. V. WILSON.